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AUTHOR Fradkin, Bernard
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ABSTRACT

The multiple image presentation format investigated in this research review refers in most cases to the use of more than one image, with or without audio synchronization, on a single screen or multiple screens, with slides or any appropriate media mix to accomplish a predetermined learning task. Studies reviewed are divided into three categories: (1) general studies, including historical studies, studies of perceptual readiness or literacy related to multiple image communication, and reviews of other studies; (2) experimental studies--those concerned with the constructs related to the design, format, information density, and redundancy of a multiple image learning message; and (3) utilization studies--those that test the multiple image presentation mode to determine its effectiveness as a means of instruction. Within each of the categories, reviews are arranged alphabetically by the last name of the author of the study or article. A complete citation is given, including ordering information or journal citation. A summary draws some conclusions and raises some questions about multiple image research. A subject index and instructions for ordering Educational Resources Information Center (ERIC) documents conclude the paper. (PF)

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A REVIEW OF

MULTIPLE IMAGE PRESENTATION RESEARCH

BY

BERNARD FRADKIN

DECEMBER 1976

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

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INTRODUCTION

Multiple image instructional presentation has become increasingly popular during the last 20 years. Its popularity is evidenced by the increasing number of presentations at the Multiple Image Festival at the Association for Educational Communications and Technology (AECT) annual convention, by improved equipment configurations, and by the design of facilities to meet the presentation demands of this format. Although the concept of multiple images has existed from caveman civilization to the present, the perceptual and learning relationships of this complex format have not been researched until recently. The purpose of this review is to bring together the research and theoretical media materials that suggest solutions to questions arising during the research, design, evaluation, and implementation of multiple image presentations for instruction.

The multiple image presentation format referred to in this research review refers in most cases to the use of more than one image, with or without audio synchronization, on a single screen or multiple screens, with slides or any appropriate media mix to accomplish a predetermined learning task. The wide range of presentation design possibilities of the multiple image definition allows for innumerable combinations of media stimuli.

The design of equipment to support multiple image presentations has progressed from manual operation, to semi-automatic with a punched card system, to full automatic, utilizing magnetic and punched computer tape. With the sophistication of the latest equipment, it is possible to program and execute more than 20 cues a second controlling most equipment functions. Production presentations that approach and actually go beyond the limitations of the human perceptual system are possible. Since the hardware

technical restraints largely have been overcome, the thresholds of human learning and perceptual processing represent the new frontiers of research in the multiple image format.

About This Paper

For the purpose of reviewing the literature, we have judged each study to fall into one of the following categories:

1. General Studies. This category covers studies that refer to theoretical or quasi-experimental type literature. Included in this grouping are studies that relate to the historical development of multiple image presentation, studies of perceptual readiness or literacy related to multiple image communication, and reviews of other studies that relate to the scope of this treatment.

2. Experimental Studies. Some studies are concerned with the constructs related to the design, format, information density, and redundancy of a multiple image learning message. Often these investigations apply to more than the multiple image presentation mode.

3. Utilization Studies. These studies test the multiple image presentation mode to determine its effectiveness as a means of instruction. This category of treatment may be referred to as a case study. In some instances multiple image presentation format is compared to one or more other methods to determine which type presentation produces the greatest learning. Often the effectiveness of the multiple image treatment is compared to conventional methodology through testing of attitude, recall, efficiency, and other significant factors.

Several large bodies of information have been excluded from this review. Omissions include popular literature on multiple image presentation format, studies related to the production techniques of materials used in multiple

image presentations, entertainment type treatments of the multiple image presentation technique, and published book chapters and text materials. Visual literacy and perceptual studies were selectively limited to reduce the huge amount of research in these areas to a proportion that would deal most specifically with the focus on multiple image presentation. Literature was found in a number of sources: Dissertation Abstracts, the Educational Resources Information Center (ERIC), AECT papers delivered at Research and Theory sessions, and a survey of bibliographies found in articles discussing multiple image presentation.

Within each of the three categories noted above, reviews are arranged alphabetically by the last name of the author of the study or article. Reviews as originally submitted were shortened and simplified by the editor to conform to space and financial limitations. The reviewers were:

Bernard Fradkin (chairman)
Evergreen Valley College, San Jose, California

Louis Berry
University of Pittsburgh, Pennsylvania

Kenneth Burke
University of Texas, Austin

Roger Gordon
Temple University, Philadelphia, Pennsylvania

Josh Meyrowitz
Center for Instructional Development, Queens College
Flushing, New York

Molly Spiro
University of Pittsburgh, Pennyslvania

A Summary by Dr. Fradkin draws some conclusions and raises some questions about multiple image research. Concluding the paper is a subject index based on key variables and terms, and ERIC document ordering information.

GENERAL STUDIES

Barlow, H. B. "Possible Principles Underlying the Transformations of Sensory Messages." In Sensory Communication, edited by W. A. Rosenblith, pp. 217-34. New York: Wiley, 1961.

The paper explores the purpose of sensory relays and advances three hypotheses: (1) Sensory relays are for detecting, in the incoming messages, certain "passwords" that have a particular key significance for the animal; (2) Sensory relays are filters, or recoding centers whose "pass characteristics" can be controlled in accordance with the requirements of other parts of the nervous system; and (3) Sensory relays recode sensory messages, extracting signals of high relative entropy from the highly redundant sensory input.

Bruner, Jerome S. "On Perceptual Readiness." Psychological Review, 64 (March, 1957), 123-52.

Perception depends upon an act of categorization; in turn, categories are built upon the inference of identity from cues. According to Bruner, all perceptual experience is a result of this categorization process. This is true, first, because all perception is generic (whatever is perceived is placed in and finds "meaning" from the class of percepts with which it is grouped). Often this categorization process is a silent or even an unconscious one. Secondly, the results of categorization are "representational"--what is perceived is a representation of the external world.

Bruner also addresses the problems of cue utilization and category accessibility. He lists two general determinants of category accessibility: (1) One's expectancies of the likelihood of the occurrence of events to be encountered in the environment and (2) the search requirements imposed by one's needs and life style. Perceiving, which involves inference, rests upon a decision process which in turn presumes a decision sequence. This sequence moves through (1) primitive categorization, (2) cue search, (3) confirmation check, and (4) confirmation completion.

To deal with these phenomena of perceptual categorizing and differential perceptual readiness Bruner proposes four kinds of mechanisms: Grouping and integration, access ordering, match-mismatch signal utilization, and gating or "filtering".

Although the article is heavily laden with an emphasis on the neurological bases of some of the phenomena discussed, a practitioner of multi-image presentation will derive pertinent information from it. The comments about redundancy to overcome inappropriate perceptual readiness, the phenomena of sensory inhibition or "filtering," and the concept of "perceptual defense" are particularly applicable to the producer and user of multimedia techniques.

Burke, Kenneth. A Functional/Experiential Approach to Criticism of Multimedia Programs. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Anaheim, California, March 29-April 2, 1976. 43pp. ED 124 104.

Burke, Kenneth. A Functional/Experiential Approach to Criticism of Multimedia Programs. Doctoral dissertation. University of Texas at Austin, 1976. 209pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 76-26,603; microfilm $7.50, papercopy $15.00).

Because multimedia presentations are used to communicate diverse ideas, and because they employ mixtures of art forms, they have resisted systematic criticism. This paper systematizes criticism of multimedia presentations by using a variety of typologies to look at the style and structure of the presentation, its value to the audience, and the critic's personal reactions. By uniting the taxonomies of traditional schools of criticism with the philosophies of aesthetics and theories of mass media, a definition was synthesized for the role of multimedia critic, and formats for systematic criticisms were formulated. Future research should use this organizational framework to further examine how media format affects perception and learning.

Burke, Larry Kenneth. A History of Multimedia. Master's thesis. University of Texas at Austin, 1972. 276pp. IR 003 803.

This paper builds upon Perrin's (1969) history of multi-imagery in education and popular entertainment. The study includes an account of projected imagery in education, public pavilions, cinema, and avant-garde art. Further, there is a lengthy account of projected imagery used on the legitimate stage and in experimental theater. The author offers a broad definition of multimedia: "The juxtaposition of two or more communications media--at least two of which must be electronically powered--to produce a total work which is different from the sum of its parts."

Events described range from the Cinéorama pavilion of the 1900 Paris Exposition to multi-screen cinema experiments in Austin, Texas in 1972. Each chapter is concentrated on a distinct time frame and is divided into four sections: Multiscreen Presentations, Electronic Media and Performers, Environmental Theater, and Environments. Half of the thesis consists of the following appendices: (1) A discussion of definitions of multimedia; (2) an annotated chronology of multimedia and related events, 1900-1972; (3) an annotated technological chronology of multimedia hardware. 1646-1963; (4) a collection of letters and original documents about various aspects of multimedia; and (5) a categorical-chronological chart of the events described in the text.

Conway, Jerome K. "Information Presentation, Information Processing, and the Sign Vehicle." AV Communication Review, 16 (Winter, 1968), 403-14.

In an earlier paper, the author (1967) proposed that the sophistication of present methodology was not matched by a parallel refinement in consideration of key substantive issues. The paper suggested that because of a failure to conceptualize the information presentation problem in a more systematic fashion, research on the multiple channel question, despite claims on its behalf, would continue to have limited relevance either to a developing theory of instruction or to the immediate concern of educators. This 1968 paper develops the earlier argument with specific reference to the adequacy of the proposed theoretical frameworks.

The general research question is the relative efficiency of the learning of redundant and related information communicated in two channels as opposed to single channel communication.

This paper implies that simplistic notions of what is available to the learner following information presentations need considerable clarification and reexamination. If it is valid to conceive of a one-item two-modes-of-available-information relationship, it may also be fruitful to consider the reverse. That is, it is equally conceivable that two information units can be simultaneously presented, with only one form of internal representation employed and available to the learner. Advances in knowledge are not a necessary consequence of what appear to be advances in methodological pre-

cision and rigor of the research endeavor. What is required now is not only better designed research studies, but better formulated research questions.

Conway, Jerome K. "Multiple-Sensory Modality Communication and the Problem of Sign Types." AV Communication Review, 15 (Winter, 1967), 371-83.

The problem considered is the relative efficiency of multiple versus single channel or modality presentations in the learning of redundant and related information. The paper discusses the conceptual and methodological status of research pertaining to this issue, and attempts to direct future investigation along more fruitful and suggestive lines.

It appears that the failure to take cognizance of modality and sign type differences in redundant and related combinations permits an ambiguity that may be carried over into the interpretation of experimental results. Analysis of the combined presentation issue indicates that it encompasses two distinct questions likely to be confounded in experimental investigation: (a) Is a presentation combination of two sensory modalities more efficient than either one of the modalities used alone for the learning of specified material? and (b) Is a presentation combination of two signs more efficient than using either one of the sign types alone for the learning of specified material? A consistent finding of previous research is that there is no advantage in using two sensory modalities over one in the learning of meaningful material. Question (b) remains unanswered.

The crucial issue brought to light is the failure to recognize and make explicit the built-in assumptions about sign learning which underlie

certain operational procedures used to distinguish between pictorial and verbal stimuli.

Fleming, Malcolm L. Perceptual Principles for the Design of Instructional Materials. Final Report. Bloomington: Indiana University, Audio-Visual Center, January, 1970. 98pp. ED 037 093.

This search of perception literature and ERIC media studies since 1960 is intended to aid instructional designers by providing guidelines based on the research. However, since the information comes mostly from secondary sources, designers are advised to test and adapt the guidelines as local feedback indicates.

Designers of instructional materials make many decisions that are probably based on evidence that is unreliable. More reliable evidence, based on perceptual and media research, has not been available in their own language. In this project the information was collated and analyzed to derive tenable principles and generalizations that can be used by practitioners who design instructional messages.

The article reviews the literature in the psychology of perception, primarily through secondary sources, and abstracts over 60 general perceptual principles. The principles are analyzed and examples are provided. Then implications for designing instructional materials are discussed.

Fleming speaks only briefly of multiple channel communications. He notes the possibility that many instructional materials are already perceptually overloaded and suggests that additional "jamming" of the perceivers' sensory channels through multimedia, wraparound screens, and 3-D sound may have negative results. Fleming suggests that the only possible instructional use of such stepped-up sensory environments is in situations where the usual teaching process of conveying information is subsidiary to a desire to "overwhelm, impress, exhilarate, or 'send.'"

Gibson, James J. "A Theory of Pictorial Perception." AV Communication Review, 2 (Winter, 1954), 3-23.

Gibson attempts to analyze how pictures convey information. He suggests that discrimination is an important aspect of perception and emphasizes pictures that duplicate as much as possible the perceptual contingencies of the "real" object or event.

Gibson is concerned with the manner in which "surrogates" serve to correspond to relativity. He defines a surrogate as "a stimulus produced by another individual which is relatively specific to some object, place, or event not at present affecting the sense organs of the perceiving individual."

Using the distinctions he develops, Gibson makes the following propositions, which are highly relevant to instructional use of pictures in any format:

1. One must learn (or know) the correspondence of a surrogate to its object to make use of it. The more conventional the surrogate is, the more learning is required to learn its correspondence with its object.

2. The more replicative or "projective" a surrogate (the less conventional) the more difficult it is to refer to abstractions. The more conventional a surrogate, the easier it is to refer to either abstractions or concrete objects (i.e., a photograph of a cat is a photograph of a specific cat while the word "cat" can refer to a specific cat or to the generic group of animals).

3. Mixed surrogates (at either extreme, such as cartoons) can indicate both concrete objects and general or typical objects.

4. A mixed surrogate cannot simultaneously incorporate high fidelity to a concrete referent and high univocality for something abstract. If the distortion is too great the meaning is often lost; if the fidelity is high the generic concept is lost.

Gibson's praise of the realistic picture for learning about specific things has been criticized by later writers who suggest that high realism in instructional visuals may "overload" perceptual channels. See, for example, Norberg (1966), and Knowlton (1966).

Gropper, George L. "The Design of Stimulus Materials in Reponse-Oriented Programs." AV Communication Review, 18 (Summer, 1970), 129-59.

This article supports the view that the impact of response practice on learning effectiveness and efficiency can be heightened by the systematic organization of stimulus materials that control such practice.

The paper includes an historical account of the development of techniques for the spatial organization of stimulus materials in response-oriented programs, and provides evidence concerning the efficiency of such techniques. It further demonstrates that the length of verbal programs and the time it takes to complete them can be substantially reduced without any loss of instructional effectiveness.

Gropper concludes his paper by stating that the techniques for organizing and presenting stimulus material are intended to facilitate response practice. The effectiveness and efficiency of instruction, in the end, rests on the type of responses practiced and on the amount of practice. It is only with this goal in mind that the spatial diagrams are recommended.

Hartman, Frank R. "Recognition Learning Under Multiple Channel Presentation and Testing Conditions." AV Communication Review, 9 (January-February, 1961), 24-43.

Three experiments are described wherein information is presented simultaneously by all possible combinations of the audio, pictorial, and print channels and subsequently tested on the same variations of combinations of three channels. The information presented was intended to be redundant between the audio and print channels and positively related between the verbal and pictorial channels.

The learning of simultaneous information presented over multiple channels follows a stimulus generalization model with respect to the number of channels in the presentation situation and the number of channels in the testing situation. The general expectation is that multiple channel presentations do not produce increases in learning over single channel presentation unless the situation in which the learning is elicited also contains the necessary additional cues.

Hartman, Frank R. "Single and Multiple Channel Communication: A Review of Research and a Proposed Model." AV Communication Review, 9 (November-December, 1961), 235-62.

The paper generally deals with three channels of information presentation--the pictorial, the auditory verbal, and the print--that are basic to all current mass media. The more particular concern is with the effects of these channels when used in combination to present information. As such, the relevance is chiefly to television, motion pictures, and other media using more than a single communication channel. The paper suggests a theoretical formulation by which the diverse results set forth in the literature may be better knit together, and also suggests clarifying experiments where reconciliation is difficult.

Hsia, H. J. "The Information Processing Capacity of Modality and Channel Performance." AV Communication Review, 19 (Spring, 1971), 51-75. See also: Hsia, H. J. "On Channel Effectiveness." AV Communication Review, 16 (Fall, 1968), 245-67.

Intensive controversy exists regarding the capacity of the auditory and visual modalities. Concentrated research has attempted to define the most effective modality or combination. Such research has resulted only in further confusion. This study attempts to integrate many of those conflicting studies and theoretical positions into a series of usable guidelines, both for developers of instructional materials and researchers in the field of information processing.

A number of conclusions are drawn from the extensive literature review. These include:

1. Human information processing functions as a multichannel system as long as the capacity of the system is not exceeded.

2. When input is greater than the system's capacity, the system becomes single channel in nature.

3. The central nervous system has a much more limited processing capacity than do either of the modality systems.

4. An increase in dimensionality does not necessarily increase the rate of information transmission.

The researcher further suggests that future research in this area focus attention on stimulus encoding processes, memory retrieval, and redundancy, rather than on simple media or modality comparisons.

Knowlton, James Q. "On the Definition of 'Picture.'" AV Communication Review, 14 (Summer, 1966), 157-83.

Knowlton argues that just as it is important to develop a meta-language about language in order to understand how we use it and how it uses us, we must develop a way of speaking about pictures.

He begins with the working assumption that for the purpose of analysis, pictures can usefully be considered to be signs. In the first part of his article, Knowlton reviews the concepts of sign, referent categories, equivalence and identity categories, sign vehicles, and referential and emotive signs.

The most significant aspects of the first section (and the basis of the second) involve Knowlton's critical look at the concept of "iconic" signs. Iconic signs are often defined simply as signs which resemble that for which they stand. Knowlton suggests that visual-iconic signs and non-sign visual displays are not clearly distinct categories but can be depicted as a continuum with variations in the degree of arbitrariness.

Following this reasoning, Knowlton in the final part of his paper makes a beginning attempt to develop a taxonomy of iconic signs which is independent of the physical attribute of the sign vehicles. He suggests that the taxonomy should be tested empirically and closes with some ideas on how pictures and language may interest or re-interpret each other and open new avenues of thought and learning.

Meyrowitz, Joshua. Conceptual Relationships in Multiple Image Instruction. New York: Queens College, 1976. 13pp. IR 003 730.

The assumption is often made that multi-image involves a high density of information with the likelihood of sensory overload. This view of multiple image as a fast-paced overwhelming medium stems, in part, from the initial use of multi-image in trade shows and world fairs where the purpose has been to impress rather than teach.

What is less discussed is the view Meyrowitz takes in this exploratory paper: Multi-image presentations need not be fast-paced and need not be confusing. In fact, multi-image can be used to clearly depict concepts which are undepictable in other ways. Multi-image is a highly flexible medium which allows for the structuring of a variety of instructional messages. The speed and complexity of the message is always within the control of the designer.

Meyrowitz suggests three possible categories of relationships in a multi-image lecture: (1) Relationships between the aural lecture and the visual presentation, (2) relationships among simultaneously presented visuals, and (3) relationships between a visual and the visuals directly preceding and following it.

The paper describes eleven potential relationships that exist among simultaneously presented messages in multi-image lectures. These are redundancy, cross-modality redundancy, general/specific relationships, comparison/contrast, interaction of variables, parallel messages, analogical messages, temporal relationships, spatial relationships, generic concepts, and ideograms. These relationships do not, however, function discretely in an actual lecture. Other variables such as types and rates of change on screens and general aesthetic considerations can interact with those relationships to create the total effect of a multi-image lecture.

An interesting bias in Meyrowitz's whole approach is his emphasis on fluidity in instruction. All examples in the paper involve a "live" lecturer, not taped narration. Meyrowitz seems to feel that multi-image is an ideal teaching instrument because of the flexibility it gives instructors both in planned design and in response to student comments and questions. Further,

Meyrowitz explicitly notes that the clear, conscious planned use of multi-image techniques is not applicable to all teaching situations. He claims that instructional goals vary, even within one lecture, and sometimes "Materials are used to stimulate discussion and the outcome is meant to be fluid and open--as much the result of student input as input by the teacher."

Norberg, Kenneth. "Visual Perception Theory and Instructional Communication." AV Communication Review, 14 (Fall, 1966), 301-17.

In this loosely structured criticism article, Norberg examines the work of Gibson, Travers, and Knowlton and tries to identify the biases and limitations of each. The author makes the point that communication and learning are two distinct processes and that much of the work in instructional communications only deals explicitly with one while taking the other for granted.

Norberg suggests that Gibson's emphasis on faithful surrogates for non-present stimuli focuses too much attention on what is in the surrogate and too little on what the viewer actually sees or learns.

The author then criticizes Travers for basing his assumptions on experiments using verbal material in both auditory and visual channels (no pictures), and explains that only within the confines of a theory based solely on the transmission of bits of information could such generalizations from verbal to visual stimulation be made.

Norberg is more positive in his discussion of the work of Knowlton, who not only distinguishes between iconic and arbitrary signs but also emphasizes that one cannot discuss the value of iconic signs without an analysis of the nature of its "iconicity" and the intent of the communicator.

How, asks Norberg, can these approaches to learning be so different? How can each researcher be satisfied with such variant and often mutually exclusive considerations? Norberg suggests that the work of Suzanne Langer and her distinction between linear and non-linear signs may provide an answer. Pictures can be used linearly as "quasi-verbal" symbols but only if they give up some of their "distinctive power as iconic signs."

Norberg emphasizes that iconic signs not only differ from linear ones in that they are perceived "all-at-once" rather than sequentially, but also because they have a degree of meaning that is not dependent upon a grammatical structure of which they are a part.

Perrin, Donald George. A History and Analysis of Simultaneous Projected Images in Educational Communication. Doctoral dissertation. University of Southern California, Los Angeles, California, 1969. 211pp. Available from University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order no. 70-00359; microfilm $7.50, papercopy $15.00).

The purposes of this study were to: (1) Compile the history of multiple-image projection as used in entertainment and instruction; (2) define the role and function of simultaneous multiple images compared to single-image projection; (3) determine the effect of simultaneous images on communication and learning; (4) analyze empirical and research evidence that relates to communication with multiple images; (5) synthesize a tentative theoretical base for the use of simultaneous images; (6) identify hypotheses needing verification through research; (7) establish guidelines for terminology, production, and presentation; and (8) predict the future role of multiple-image communication in education.

While it would have been virtually impossible for any single study to accomplish all of these goals, Perrin's does an admirable job of addressing the total field of multimedia communication.

Even though research findings seem to indicate little superiority of multi-images over single images, Perrin optimistically offers the first coherent theory of multi-imagery: Simultaneous images on a large screen (or adjacent screens) create a pattern of information comparison and simultaneous visual montage, thereby increasing information density and facilitating certain types of learning. Some of the types of learning most appropriate to the multi-image method are comparisons, contrasts, details, interrelationships, and steps in a process.

It is clear that Perrin succeeded in giving order, direction, and stability to the newly-emerging multimedia discipline. An examination of later research studies provides some validation of his theory of the proper use of multi-imagery.

Severin, Werner. "Another Look at Cue Summation." AV Communication Review, 15 (Fall, 1967), 233-45.

In this theoretical article, Severin attempts to explain the contradictory findings of those studying multiple channel communication. How is it, asks Severin, that some studies show an increase in learning in cross-channel redundancy while others do not?

After critically reviewing the literature, Severin makes theoretical predictions for multiple channel presentations, including the following:

a. Presentations that combine audio with related or relevant pictures will lead to the greatest gain in information because of cue summation between channels.

b. Presentations that combine words in two channels (aurally and in print) will not lead to significant gains over single channel communication because no additional cues are provided.

c. Presentations that involve unrelated cues will cause interference and result in lower gains than single channel communication.

d. Single channel presentations will be superior to (c), inferior to (a), and equal to (b).

Although Severin does not specifically speak of multiple image communication, his theorem suggests that multi-image can have a positive effect on learning through cue summation because it allows for simultaneous presentation of relevant cues.

Spaulding, Seth. "Research on Pictorial Illustration." AV Communication Review, 3 (Winter, 1955), 35-45.

This article reviews the few studies that considered the varying effectiveness of pictorial illustrations as a communications medium. Most illustration research was confined to studies of children's preferences for illustrations of different styles, color, and page placement. It was found that effectiveness of illustrations in children's books depends primarily on age level. Young children prefer illustrations with brilliant colors, little detail, and plenty of action.

Other reports conclude that, to be effective, illustrations should cover at least half the page. Because of typical eye movements, the area of significant interest should appear in the center and upper left of the picture with the horizontal plane emphasized.

Although this review covers a period from 1930 to 1953, only recently have we seen a movement to apply some of the findings. The visual literacy movement addresses the question of training viewers to accurately interpret visuals.

With the more sophisticated children of the "Electronic Age," would findings concerning simplicity, reality, and color rending still apply? Many of the conclusions presented have particular application to illustrations used in color TV as well as for book illustrations.

Travers, R. M. W. "The Transmission of Information to Human Receivers." AV Communication Review, 12 (Winter, 1964), 373-85.

This classic paper explores research related to two widely held concepts of audiovisual presentations:

1. The assumption that multiple channels or modalities, when used to transmit information, will result in increased learning or retention.
2. The assumption that the more realistic a presentation, the more effectively it will facilitate the transmission and retention of information.

The researcher analyzed theoretical and experimental reports by Broadbent, Hernandez-Peon, Cherry, Van Mondfrans, Reid and Chan, and Van Mondfrans and Travers and drew a number of conclusions regarding the first assumption:

1. No superiority was found by transmitting information simultaneously through both auditory and visual modalities, except in cases where extremely high rates of information transmission are involved.
2. Switching from the auditory to visual modalities or the reverse results in reduced rates of information transmission.
3. The use of unique cueing devices to direct attention to information presented in one modality results in a reduction of information gained from the other modality.
4. The data reviewed support the descriptions of the human information processing system as a single channel system, made by Broadbent (1958) and Feigenbaum and Simon (1963).

The second assumption regarding the realism of stimuli also was explored. Travers concludes that the use of embellished or overly realistic materials may tend to present the perceiver with too many irrelevant stimuli, thereby resulting in an overload of the information processing system.

EXPERIMENTAL STUDIES

Allen, William H., and Cooney, Stuart M. A Study of the Non-Linearity Variable in Filmic Presentation. Los Angeles: University of Southern California, May 1963. 179pp. ED 003 563. AV Communication Review, Summer, 1964, pp. 164-76 and Fall, 1964, pp. 302-24.

Researchers studied the effects upon learning of (a) visual images presented non-linearly and (b) visual images presented linearly. Also studied were the effects of similar content delivered with emphasis upon (a) description of factual content using pictorial representation, (b) explanation of conceptual content using symbolic representations, and (c) a mixture of these two extremes. The study sought to clarify requirements for effective design of informational messages.

Over 1,000 sixth and eighth grade students were randomly assigned to one of six groups to view filmographs on flowcharting. Each filmograph contained essentially the same information but varied in format and treatment.

The conclusions indicate that the mode of presentation has less effect on learning as students mature; the ability to comprehend and apply subject matter of this type taught in these ways improves with age.

The second part of this study presents a review of the literature to that date and further offers recommendations for design process, structure, and development, with suggestions for future research in this area.

Attneave, Fred. "Some Informational Aspects of Visual Perception." Psychological Review, 61 (May, 1954), 183-93.

This article explores how information theory techniques may clarify understanding of visual perception. Operating on the theory that much of the information received by any higher organism is redundant, the author proposes a type of "guessing game" to measure a subject's ability to recreate a figure on a sheet of graph paper. The subject's behavior demonstrated that redundant visual stimulation results from either (a) an area of homogeneous color or (b) a contour of homogeneous direction or slope.

Further experiments relevant to (b) demonstrated that information is concentrated at points where contour changes direction most rapidly. (No statistical data cited.) Symmetry and texture also constitute forms of redundancy.

The author presents a list of ten "reduction principles" to encode incoming information in a more economical form, grouped according to forms of redundancy. The article seems to be of value to learning psychologists but, until presented in more familiar terms, may not be of great use to instructional technologists.

Berry, Louis H. Interactive Effects of Color Realism and Learner I.Q. on Visualized Instruction. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Anaheim, California, March 29-April 2, 1976. 26pp. IR 004 032.

Berry, Louis H. An Investigation of the Effectiveness of Realistic and Non-Realistic Color in Visualized Instruction. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Dallas, Texas, April 13-17, 1975. 22pp. IR 004 033.

This study examined the relative instructional effectiveness of two forms of color cueing used in audiovisual instructional materials.

Some 224 college students were presented with an instructional unit on the human heart illustrated with either realistic, non-realistic, color, or black and white materials.

The results indicate that an interaction does exist between learner intelligence and the degree of realism presented in visuals. Higher and average intelligence learners gained significantly more from realistic visuals, while it appeared that non-realistic or stylized visuals aided only high intelligence students. It was concluded that visual realism can be edited and should be used selectively to aid students. However, stylized materials should be avoided when designing materials for students of varying learning abilities.

Bollmann, Charles Gene. The Effect of Large-Screen, Multi-Image Display on Evaluative Meaning. Doctoral dissertation. Michigan State University, East Lansing, Michigan, 1970. 185pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 71-11,789; microfilm $7.50, papercopy $15.00).

This study compared single-image and multi-image presentations for evaluative meaning (affective response) and explored the relation of evaluative meaning to distance from screen.

The program was a 10-minute slide and music treatment of biochemistry, selected to be a neutral topic for the 71 education major subjects. From the 20 evaluative scales used to rate basic evaluative concepts, three factors emerged: (1) Main evaluative factor (good-bad), (2) well-being factor (happy-sad, healthy-sick), and (3) second evaluative factor (true-false). For two of the five basic evaluative concepts, the multi-image group's scores were high significant. However, there were no other significant results even though there was a trend in favor of more positive responses coming from the multi-image group. Specifically, there were no significant differences in comparing the two treatment groups. Also, no significant differences resulted from the subjects' location from the screen, although the best responses came from those who were closest and farthest from the screens.

Nothing definite about the effects of multi-imagery can be stated based on the results of this study. There is no indication of why Bollmann's affective test was unsuccessful while Reid's was successful. A strong possibility, though, is that Bollmann's use of multi-imagery was not sufficiently different from single imagery to result in any differences.

Bollmann suggests that future studies should match program content to intended audiences for more significant results; he also suggests that in

McLuhanesque terms the "hot" self-contained medium of photography may become "cool" in the multi-image format.

Burke, Kenneth. Worship and Multimedia. August, 1973. 16pp. ED 124 204.

In the spring of 1971 a study was conducted at various religious student centers at the University of Texas at Austin to determine the effectiveness of a multimedia presentation in several worship services. Effectiveness was defined as: (1) Acceptance of the quality of the presentation by a distinct group of viewers, and (2) their recognition of cognitive challenges presented by the show. A multimedia presentation based on excerpts from the rock opera "Jesus Christ Superstar" was shown during a one-month period. The results indicated that: (1) The particular congregations chosen did prove distinct in terms of orthodoxy, (2) the hypothesis that unorthodox worshippers would be more positively responsive to this multimedia presentation than would orthodox worshipers was not statistically confirmed, and (3) orthodoxy group and test group scores on the "Superstar" evaluation factors indicated that the presentation was effective since it was qualitatively lauded by all groups and was received best by the more unorthodox Protestants.

No statement can be made comparing the effectiveness of a multimedia program to other media in the context of a worship service. This study failed to show a significant response in favor of the multi-image presentation. The only related study is Reid's (1970) dissertation comparing single-image and multiple-image versions of a film shown to church congregations. In two of three cases, Reid found better response in terms of time and money commitments to the church with the multi-image film. Reid's positive results and Burke's positive trends indicate support for thoughtful multimedia programs used for worship, but nothing definite can be concluded from these two studies.

Carterette, E. C., and Jones, M. H. "Visual and Auditory Information Processing in Children and Adults." Science, 156 (May 19, 1967), 986-88.

Researchers examined the influence of linguistic redundancy upon the learning of verbal materials, using 256 subjects; 64 each at first, third, and fifth grade reading level and one group of adults. The experimental task required the continuous processing of sequentially presented information for recognition after filled time intervals of varying length. Half the subjects (32) were tested visually using slides while the other half were tested auditorially with an audio tape.

Modality was a significant factor in language processing, suggesting that the two modes are not equally effective at all ages. Among other conclusions:

Not surprisingly, when some aspects of memory coding for verbal material are involved, children will be inferior to adults. In adults visual processing of information is at least as good as auditory.

When the child begins school, auditory perceptual skills are superior to visual perceptual skills. However, once training begins, heavy demands are made on visual skills in reading; hence visual learning rapidly increases. By the fifth grade, visual performance of the child approximates that of the adult.

Danner, Fred W., and Taylor, Arthur M. Integrated Pictures and Relational Imagery Training in Children's Learning. Paper presented at the Annual Meeting of the American Educational Research Association, Chicago, Illinois, April, 1972. 19pp. ED 066 757.

The effects of integrated pictures of nouns, training in imagining relations between separate pictures of nouns, and the combination of training and integrating pictures on the recall of noun triplets were assessed in children from grades one, three, and six. The cued recall of nouns under these three conditions was from two to six times greater than that of the control group in all three grades. In grade six, the children who had been trained to generate their own relations between the pictured nouns recalled significantly more than those who had been shown integrated (i.e., already related) pictures of the nouns.

All three experimental conditions facilitated recall. The integrated pictures were effective at all ages, perhaps because of their humorous content. Nevertheless, there seemed to be an increase with age in the spontaneous use of relational strategies. However, contrary to previous beliefs, the authors feel that the effectiveness of this imagery training on the first grade children indicates that such training could begin effectively much earlier than the sixth grade.

Dwyer, Francis M., Jr. A Study of the Relative Effectiveness of Varied Visual Illustrations. Final Report. University Park: The Pennsylvania State University, Division of Instructional Services, September, 1967. 173pp. ED 020 658.

The relative effectiveness of eight types of visual illustration of the human heart was tested in ninth through twelfth grade classes. The eight types--abstract line drawings, detailed shaded drawings, photographs of heart models, and realistic models, each in black and white and in color--and a control presentation with no illustrations were assigned randomly to one class each per grade level. Each treatment consisted of a tape recorded oral presentation on the heart, and 39 slides that were identical in size and format to the slides in each other treatment.

The abstract linear representations were superior to more "realistic" presentations, probably because they isolated material to be learned and did not present other irrelevant stimuli. Significant differences existed on the immediate posttests, but on the delayed measurement, differential effects of the nine treatments disappeared for all tests for all four grades, with one exception.

The researcher concluded that the most realistic visuals are not necessarily the most effective in promoting learning. Similarly, in many cases, visuals are not necessary at all to optimize the instructional effectiveness of oral instruction. He further concluded that visual material does not appear to significantly affect the retention of material after a delay of two weeks.

Hsia, H. J. "Intelligence in Auditory, Visual and Audiovisual Information Processing." AV Communication Review, 17 (Fall, 1969), 272-82.

The study was conducted to determine the instructional relationship between modalities and learner intelligence. Some 192 seventh grade subjects were presented with visual, auditory, and audiovisual versions of ten poetry verses. Variables of noise and sequencing or constraint were manipulated under each condition.

Students of differing intelligence levels varied significantly in terms of information loss and recall. These differences were not evident in the audio and audiovisual channels when output data were analyzed. No differences were found among students when error data related to the visual channel were analyzed. The researcher concluded that lower intelligence learners could be aided by controlling input, noise, and redundancy of information. Use of the audiovisual rather than a single channel was recommended as a means whereby the processing rate of lower intelligence learners could be optimized. It was further suggested that in using such audiovisual channels, the between channel redundancy be kept high.

Menne, Joy M., and Menne, John W. "The Relative Efficienty of Bimodal Presentation as an Aid to Learning." AV Communication Review, 20 (Summer, 1972), 170-80.

The study was undertaken as a preliminary step in the investigation of whether simultaneous aural and visual presentation of redundant materials results in better learning than either aural or visual presentation alone.

All 36 subjects from the third grade were tested under three treatment conditions--aural, visual, and aural-visual combined--each with three different simple four-line verses.

The results clearly indicate that the subjects participating in this study learned a significantly greater proportion of the simple four-line verses from simultaneous aural-visual presentation than from either aural or visual presentation alone. For the learning task at hand, visual presentation was the most effective of the single modality presentations.

Reid, Robert Orlo. A Comparison of a Multi-Image and a Linear Film Format as Agents of Attitude Change. Doctoral dissertation. Syracuse University, Syracuse, New York, 1970. 105pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 71-10,966; microfilm $7.50, papercopy $15.00).

Researchers studied the success of attaining affective objectives in religious education through the use of a multi-image display format. They were aware of previous studies that showed success with the medium of film and wanted to test the effect of film image format. Two versions of a 32-minute 16mm film, That All May Be One, were produced. Subjects were randomly assigned to one of three treatment groups, providing a total of nine treatment groups. One group in each congregation saw the single-image film, one group saw the multi (5)-image film, and the control group received a speech on the topic but no film.

Favorable responses to the concept and to the films were measured by means of immediate time and money commitments to the church social action program.

Both film groups contributed significant amounts of time and money compared to their respective control groups. Further, in both of these cases, the multi-image group contributed significantly more than the single-image group.

For affective responses with a church group, film is an effective medium of communication and a multi-image film is even more effective. However, significant problems seem to arise when the presentation conditions are not good and when the film content is not keyed to the congregation's existing predispositions. Similar findings testing multi-imagery in a religious context are reported by Burke (1973).

Sparks, Jerry D. The Role of Context in Recognition Memory for Pictorial Materials. Paper presented at the Association for Educational Communications and Technology Annual Meeting, Anaheim, California, March 29-April 2, 1976. Available from: Jerry D. Sparks, Assistant Professor of Educational Media, 607 Aderhold Hall, University of Georgia, Athens, Georgia 30602.

The main purpose of this study was to determine whether the presence of pictorial context affects recognition memory for pictorial material. The two main stimulus types were: (1) Pictures with a single primary simulus and (2) pictures with a primary stimulus surrounded by contextual stimuli. Drawings by three artists provided an additional variable to determine the effect of artistic rendering on recognition memory for pictorial material.

The major findings of this study were: (1) Recognition memory for outline drawings consisting of primary stimulus with surrounding contextual elements was clearly superior to recognition memory for outline drawings without contextual elements, (2) In recognition memory for outline drawings, various artistic renditions have a differential influence on subjects' performances, and (3) The effectiveness of a particular artist's renderings of outline drawings is consistent (in relation to other artists' renderings) across context types.

Conclusions of the study were: (1) Contextual elements facilitate recognition memory for pictorial materials, (2) Different artistic renderings are a factor in the effectiveness of an illustrated message, and (3) Artistic renderings that yield the highest recognition memory scores in any one context type will yield the highest recognition memory scores in the other context type.

Urmer, A. H. "Performance Degradation Effects of Information Loading." Perceptual and Motor Skills, 23 (1966), 1117-18.

Urmer studied the relation between declining motor performances and information input rate, using 27 males as subjects.

On a simulated military display system, two series of 32 slides each representing air traffic data were presented. From five to 18 information variables were contained on the slides, which were displayed in durations of 2, 4, 6, 8, or 10 seconds. Subjects were required to identify the information presented.

The rate of information transmission was found to be directly proportional to the duration of presentation and inversely proportional to the total information available. Up to the rate of one variable per second, subjects were able to comprehend a mean amount of 2.2 to 3.0 variables. By the rate of 2.0 variables presented per second, comprehension had fallen to about .06 variables comprehended.

High rates of perception and performance can be maintained if information variables are kept to the rate of one per second. Faster rates will result in drastically lower levels of performance; however, these lower performance levels will remain constant even as the information rate continues to increase. The implication here is that even though we can perceive about five separate items of information per second, we are able to use only about one of these items per second. As presentation rates increase we lose even more information as our channel capacity is more quickly filled.

Allen, William H., and others. Effectiveness of Different Combinations of Visual Presentation Modes in Teaching Different Kinds of Learning Tasks. Final Report. Los Angeles: University of Southern California, September, 1970. 139pp. ED 044 759.

This study had as its purpose the investigation of visual-verbal presentation modes when used for instruction in different types of learning tasks with learners of differing mental abilities. Five parallel experiments were conducted, each for a different learning objective or task (identification, comparison, classification, generalization, and application). Seven stimulus sequences were designed for each content area conforming to seven visual-verbal modes of presentation. Subjects were 617 fifth and sixth grade students.

Among the results and conclusions were: (1) The motion picture-sound and still picture-sound treatments were generally superior to all other modes for identification, comparison, classification, and general learning objectives; (2) High mental ability subjects achieved at a higher level than the medium and low ability subjects, but there was little difference in the achievement between medium and low mental ability groups; (3) Pictorial (motion picture and still picture) multi-channel sound treatments tended to show superiority over single-channel treatments, but this superiority did not hold for multi-channel verbal print/sound over single-channel print only; (4) As higher order skills were tested, there was a trend toward a decreased influence of the visual-verbal mode of presentation; and (5) Little evidence emerged that a hierarchical pattern existed between higher order and lower order tasks for learning of cognitive information.

Atherton, Lawrence Lee. A Comparison of Movie and Multiple-Image Presentation Techniques on Affective and Cognitive Learning. Doctoral dissertation. Michigan State University, East Lansing, Michigan, 1971. 129pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 71-31,154; microfilm $7.50, papercopy $15.00).

The purpose of this study was to compare cognitive and affective learning from a multi-image slide/tape program and a single-image 16mm film.

Atherton replicated the situations of previous research in multi-imagery trying to find some significant success with this method when used with older learners. No cognitive gain over single-image presentations had been found by Allen and Cooney (1963) or by Lombard (1969); no affective superiority had been found by Bollmann (1970). Like Bollmann, Atherton was not aware of Reid's (1970) success with multi-imagery for affective responses. One new twist to Atherton's study was the comparison of two different media: A slide/tape program and a 16mm film.

No significant differences were found between the responses of the two test groups, but the trends were in favor of the film group for cognitive gain and in favor of the slide/tape group for affective responses. One important result is that both presentations were significant in producing cognitive gain and positive affective response; however, these test groups were not compared to a control group.

Atherton states that the narrative structure of his presentation limited the potential of the multi-image medium. Thus, by his own admission, neither of his presentation treatments utilized their normal,

dominant characteristics. This failure on the part of most of the early multimedia researchers may account for their lack of significant results.

Brydon, William Pershing. Comparing Single-Screen and Three-Screen Presentations. Doctoral dissertation. University of Southern California, Los Angeles, California, 1974. 89pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 74-17,328; microfilm $7.50, papercopy $15.00).

This study compared one-screen and three-screen slide/tape programs for cognitive effectiveness and affective response, using 31 Lockheed Aircraft employees and 130 tenth grade students as subjects.

Three different presentations were made, each with a single-screen and multi-screen version. The multi-image versions of the Lockheed programs were significantly better for cognitive recall. For affective results with the high school students, 58.5 percent of the three-screen group changed opinions about drug use as compared to only 35 percent of the one-screen group.

Despite the fact that only Reid (1970) and Ingli (1972) were previously able to demonstrate superiority with multi-imagery, Brydon scored a resounding success. He attributes it to greater sensory stimulation with the complexity of multi-imagery. Unfortunately, Brydon was not familiar with most previous studies. His oversights are all the more important since his is the only study that shows conclusive superiority for all uses of the multi-image style of presentation. Possibly some of the earlier studies would have shown more positive results if the advantages of multi-imagery had been exploited more fully. Still, the studies of Tim-Kui Tam and Reeve (1971) and Meyrowitz and Fradkin (1975) fail to show significant results when comparing varied multi-image patterns to simple, sequential images in the multi-image format. In other words, adding one slide at a

time to a triptych configuration seems no more effective than varying the pattern and number of images.

In summary, it is very unclear what advantages can be claimed for multi-imagery, except for an empirically-observed positive response to this method of presentation. However, when comparing fully-developed multi-image programs to similar single-image presentations, there is some statistical evidence of cognitive and affective superiority with multi-imagery. A general conclusion might be that the affective response to a well produced multi-image program justifies the expense of producing the program. If cognitive responses are all that matter for a given situation, though, a good single-image program would be the better investment.

Deutschmann, P. J.; Barrow, L. C., Jr.; and McMullan, A. "Efficiency of Different Modes of Communication." AV Communication Review, 9 (September-October, 1961), 263-70.

This study tested the learning of relevant and irrelevant information by comparing achievement in a natural or traditional laboratory with student achievement in three other settings: Closed circuit TV, film only, and film in conjunction with a laboratory.

"Relevant" test scores showed no significant differences attributable to film vs. lab comparisons. For the "irrelevant" test scores the predicted difference between film and lab conditions was not found. However, the film groups obtained significantly higher channel efficiency scores than the lab groups.

The authors predict the effectiveness of the four communications situations as: First, television reproduction of film; second, film only; third, laboratory plus film; and fourth, natural laboratory. However, this study reports the results of only two modes--lab and film only. The channel efficiency index scores were in the predicted direction; results on the tests of the hypotheses were inconsistent. Further studies should examine all four communication modes.

Didcoct, Don H. Comparison of the Cognitive and Affective Responses of College Students to Single-Image and Multi-Image Audio-Visual Presentations. Doctoral dissertation. University of Wisconsin, 1972. 95pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 72-22,086; microfilm $7.50, papercopy $15.00).

This study compared single-image and multi-image presentations for learning effectiveness. Didcoct was aware of the research of Allen and Cooney (1963), Lombard (1969), and Bollmann (1970); thus, he had reason to believe that multi-image presentations did not show effectiveness that justified the time and money necessary to produce them. To try to find a clear, final answer, he used four test groups and two different programs, each program with a single-image and a multi-image version. The contents of each program were the same, but the advantages of each presentation mode were utilized, unlike the situations of most of the previous multi-image research.

For both programs, the single-screen version received a higher cognitive score. The multi-screen versions of both programs received more positive affective scores, but not at acceptable levels of significance.

Didcoct seems to validate the previous findings of Allen and Cooney, Lombard, and Atherton (1971) that multi-image presentations are equivalent to single-image presentations for cognitive achievement above the sixth grade level. Affective trends in favor of multiple imagery were confirmed, but not at significant levels. Didcoct admits that his second program had a relatively poor audio track and feels that it created too much confusion in the multi-image version. Certainly the significant cognitive score

in favor of the single-image program and the 64 percent negative reaction to the multi-image version of the second program support this analysis. Thus, one new finding of this study is that a poorly-made multi-image program is inferior to a comparable single-image program.

Ingli, Donald A. Teaching a Basic Audiovisual Course by the Multi-Image Technique. Carbondale: Southern Illinois University, College of Education, April, 1972. Paper presented at the Association for Educational Communications and Technology Annual Conference, Minneapolis, Minnesota, April 16-21, 1972. 31pp. ED 060 634.

A pilot study to evaluate the effectiveness of multi-image audiovisual teaching showed this technique to have a definite advantage over conventional single-image audiovisual aids. The multi-image technique involved using two or more visual aids designed to interact with and to amplify each other. Experimental and control groups of college students were given courses utilizing the different audiovisual approaches.

Comparing students from the College of Education, Communication and Fine Arts, and "Other" colleges of the University showed the highest gain for the experimental group from the College of Education. The lowest gain was made by the control group in "Other" colleges. In contrast, the multi-image approach proved worthwhile for the experimental group from "Other" colleges. Opinion questionnaires showed all students generally approving of the experimental approach.

The fact that audiovisual materials are less commonly used in "Other" colleges may account for the significant difference when data were analyzed according to college. Perhaps the novelty factor, which apparently held the attention of students from "Other" colleges, resulted in their significantly different scores. Three factors indicate that the experimental technique would seem to be both effective and efficient. First, the achievement of the experimental group was statistically significant; second, the experimental classes were considerably larger than the control groups; and finally, the experimental classes completed the course in 85 percent of the time traditionally required.

Lombard, Emanuel Sphardi. Multi-Channel, Multi-Image Teaching of Synthesis Skills in Eleventh Grade United States History. Doctoral dissertation. University of Southern California, Los Angeles, California, 1969. 130pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 70-356; microfilm $7.50, papercopy $15.00).

The research compared three-screen simultaneous presentations to one-screen serial presentations for teaching a complex intellectual operation, using 85 eleventh grade students as subjects.

This is the first piece of multi-image research done after the Allen and Cooney (1963) study. This study was intended as a test of their findings that multiple images lose educational effectiveness above the eighth grade level.

Based on the presentation method, there were no significant differences between the responses of the experimental and control groups. There was an indication that the multi-image method of presentation may be more successful with lower scholastic achievers. This would be in accordance with Allen's and Cooney's finding that multi-imagery is more successful with less mature minds.

Boys are apparently better at historical synthesis than girls, but neither group benefited from the method of presentation, thus confirming the Allen and Cooney results for older learners. However, both treatment groups scored higher than the control group and the three-screen group of girls (who had lower initial scores than the girls in the control group) scored significantly better than the control group girls. This indicates beneficial use of multi-imagery with slower learners.

Later writers have commented that Lombard's limited use of the

multi-image format negated any possible advantages from this mode of presentation. Similar results in later studies seem to confirm this observation.

Meyrowitz, Josh, and Fradkin, Bernard. Design of Multi-Image Instructional Presentations. Paper presented Annual Meeting of the Association of Educational Communications and Technology, Research and Theory Division, Dallas, Texas, April 13-17, 1975. Available from: Bernard Fradkin, Evergreen Valley College, 3095 Yerba Buena Road, San Jose, California 95121.

This study was conducted to identify possible advantages of multi-image instructional presentations. Meyrowitz and Fradkin theorized that multiple image instructional presentations had two potential advantages over single image presentations: Visuals could remain on the screen for an increased time and the physical juxtaposition of visuals could reinforce conceptual relations described orally.

They designed three versions of a slide/tape presentation on body language--(1) single screen, (2) triple screen, and (3) varied triple screen. Each presentation was shown to two groups of undergraduate students.

As predicted, the "relationship biased" presentation showed the best results. The "time biased" presentation led to the worst results, with the single image presentation ranking between the two multiple image presentations. The results indicated significant differences between the two multi-image presentations but no significant differences between the single image and the multi-image.

The authors concluded that the potential advantages of multi-image over single image presentations are not related to the time allowed to view visuals but to the ability of multi-image to visually reinforce conceptual relationships.

Rosonke, Richard James. A Study of the Effectiveness of Three Visual Attention-Directing Devices on the Recall of Relevant Information from Line Drawings. Doctoral dissertation. The University of Iowa, Iowa City, Iowa, 1974. 87pp. Available from: University Microfilms, 300 N. Zeeb Rd., Ann Arbor, Michigan 48106 (Order No. 75-1250; microfilm $7.50, papercopy $15.00).

Rosonke, Richard J. A Study of the Effectiveness of Three Visual Attention-Directing Devices on the Recall of Relevant Information from Line Drawings. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Research and Theory Division, Dallas, Texas, April 13-17, 1975. 40pp. IR 004 172.

The research sought to evaluate the effectiveness of various visual cues in directing attention to particular portions of pictures.

Groups of first and fourth graders were randomly assigned to a control or experimental group. All groups were shown a similar set of transparencies. All groups received an auditory/visual presentation. The audio tape asked students to note a particular portion of a figure on each transparency. In the control groups this was the only indication of the correct part of the picture to be selected. In the three experimental groups, however, additional visual cues were added: Small arrows, large arrows, and a pointer.

After viewing the transparencies, subjects were asked to recall a specified portion of each drawing.

It was found that for the fourth graders, the addition of visual cues as a whole made little difference in the accuracy of their responses on the test. The aural cues were apparently sufficient and they all did well. For the first graders, however, significant differences were found between

auditory cueing alone and all cueing devices. The pointer proved to be superior to the arrows, and far superior to auditory cueing alone.

Rosonke concluded that visual attention-directing devices can increase performance in identifying portions of pictures when the subject matter is difficult for the viewer. He suggested that the use of cueing devices should be explained to students since their purpose varies.

Rosonke's findings suggest that as the complexity of a multi-image presentation increases relative to the viewer's experience it becomes more difficult for the viewer to isolate significant details even when aurally cued. Tests with older audiences and more complex presentations are needed.

Severin, Werner. "The Effectiveness of Relevant Pictures in Multiple-Channel Communications." AV Communication Review, 15 (Winter, 1967), 386-401.

This study tested the teaching effectiveness of relevant pictures in a multi-channel communication with 201 junior high school students. Each group of students was given one of the treatments: A taped audio message only, a print message only (on slides), combined audio and print message, audio with simultaneous related pictures but of a similar category, or audio with totally unrelated pictures.

Severin predicted correctly that: (1) The group receiving audio with related pictures would show the highest score; (2) Because of the absence of cue summation, the audio print combination would not be significantly better than print alone; (3) Print alone would be significantly better than audio alone; and (4) The presentations with audio words and unrelated pictures were expected to have the worst results.

The only surprising result was that the condition of most irrelevant cues resulted in better recall of pairs than the treatment with the more relevant cues. The findings also indicated that individual intelligence score differences were less significant in changing test scores than were the types of treatment. For example, even the lowest-ranged intelligence group fared better with the audio and related pictures than did any high intelligence group with any of the other treatments.

Severin suggested that the application of cue summation theory to multiple channel communications offers an explanation for the conflicting findings in earlier studies. While Severin does not specifically deal with

multiple image presentations, his theories, research, and discussion are highly relevant to any multiple channel communications environment.

Tim-Kui Tam, Peter, and Reeve, Robert H. The Image-Accumulation Technique as a Variable in Multiple-Image Communication. Terre Haute: Indiana State University, School of Education, 1971. Paper presented at the Annual Meeting of the Association for Educational Communications and Technology, Philadelphia, Pennsylvania, March 22-26, 1971. 44pp. ED 048 734.

Researchers studied the effectiveness of various techniques of organizing and cumulating images in multiple screen slide/tape presentations to convey geographical information. The treatments consisted of (1) slides projected sequentially on one screen, (2 and 3) slides projected cumulatively and regularly on two and three screens respectively, and (4 and 5) images programmed on two and three screens respectively. In all treatments the length, taped narration, and sequence of slides were identical.

No significant differences were found in (1) the relative effectiveness among the five modes of presentation, (2) the mean scores between males and females, and (3) the interaction effects between sex and modes of presentation. However, in most cases the multi-image presentation produced higher scores. The highest mean scores were from the programmed tape accumulation technique.

The advantages of the programmed accumulation technique might be significant over a longer instructional period, with different age groups or subject matter.

SUMMARY

Research related to the multiple image format has come a long way in a short time. Of the 43 studies included in this review, 85 percent have been reported in the last ten years and 50 percent have emerged in the past five years. Although this does not represent a knowledge explosion, it does indicate a trend toward increased investigative interest into multiple image instructional communication.

It would probably be most productive to discuss the general, experimental, and utilization categories separately, since they each represent specific areas of concern.

General

The general category reflects a strong interest in the study of the perceptual area (Bruner, Gibson, Norberg, Travers). In some cases, as in Bruner, the direct application of the perceptual principles seems hard to perceive. However, we do have some definite guidelines supplied by Fleming's work on perceptual principles as they apply to design instructional presentations. The word "guidelines" should be stressed as there is a considerable amount of gray area around which the visual designer must work, i.e., in using several pictorial elements, how many "items" do they represent? How do we measure, in advance, the experience and channel capacity of a particular audience? We may need to design a standardized multiple image literacy test.

The general section includes the first discussion of criticism of "multimedia" programs (Burke). The validation of this criticism model will provide the presentation designer a standardized tool for evaluating

comparative presentation effectiveness. Primary to the development of "multimedia" criticism was the definition of terms describing the relationships of multiple image in its different functional forms and its internal conceptual framework (Meyrowitz). Meyrowitz proposes the acceptance of the multiple image format as a separate, unique communication vehicle that is a whole and not the sum of several channel components. This view suggests that careful multiple information flow design can overcome the sensory overload condition.

Experimental

The experimental studies represent broad interests ranging from very concrete questions related to realistic and non-realistic color in visualized instruction (Berry), to the investigation of information theory application to visual perception (Attneave). The important questions raised by the studies illustrate the variety of concerns the multiple image producer must consider in designing the visual product. There are several questions that must be raised in relation to this group of studies:

1. How generalizable is the information presented?
2. To what extent do these studies ask questions pertinent to the scope of multiple image instructional communication?
3. Why do these studies seem mutually exclusive except for some overlap in the treatment of pictorial material?

Authors offered several suggests for future research:

1. Match program content to audiences for more significant results (Bollmann).
2. Investigate the "hot" self-contained medium which may be "cooled" in the multiple image format (Bollmann).

3. Study further the isolation of specific elements of visuals and presentations by observers (Attneave).

The role of experimental research applied to visual presentation design is essential to the basic structure of the communication message. A productive research endeavor requires a scheduled program of questions establishing priorities and sequencing the growth of information linking variables, samples, and treatments, so we can draw reasonable generalization (Dwyer).

Utilization

The utilization studies do not present a clear case for use of multiple image communication on any generally acceptable criteria. There are several fundamental reasons for the lack of direction:

1. There are few comparable accounts of treatment and result between studies.
2. When two or more treatments were compared, there was no test indicating the forms tested were equal in any way.
3. In some cases, treatments were administered without careful analysis or prior knowledge.
4. Design of the multiple image treatment did not necessarily use the inherent characteristics of the format (Atherton, Lombard). Posttests did not measure the "type" of information multiple image techniques can best communicate (i.e., Meyrowitz study).

The future study of multiple image presentations employing improved techniques will yield a more comprehensive understanding of the multiple image role in instruction.

This project was undertaken to organize and better understand the research and study material available to the researcher and designer interested in multiple image. The continual growth and interest in this area needs direction and a foundation on which to build. We hope this review has helped provide a framework for this to occur.

G = General Studies
E = Experimental Studies
U = Utilization Studies

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